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| 09/873,264 | 06/05/2001 | Toru Uchida | 010726 | 6047 |

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EXAMINER

BAUMEISTER, BRADLEY W

| ART UNIT | PAPER NUMBER |
|----------|--------------|
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2815

DATE MAILED: 12/03/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.
09/873,264

Applicant(s)
Uchida et al.

Examiner
B. William Baumeister

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on Sep 25, 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-17 is/are pending in the application.
- 4a) Of the above, claim(s) 16 and 17 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-15 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
*See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). 3, 4 6) ☐ Other:

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DETAILED ACTION

Election/Restriction

1. Applicant's election without traverse of Group I in Paper No. 7 is acknowledged.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 4, 6, 8, 10 and 12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. These claims set forth that the thickness of the second layer satisfies the equation $L_{2nd} \leq (0.9 \times L^{1/4} \times \epsilon)$, wherein ϵ is the strain of the first layer. Since the strain will have a value on the order of tenths of a percent (e.g., within the range of 0.2% to 0.6%), it is unclear whether the value to be employed in the equation for ϵ is intended to include the decimal places attributable to the percentage. Restated, for a given strain of 0.5%, it is unclear whether the claim intends the value to be inputted into the equation for ϵ is 0.5 or alternatively, 0.005. As this ambiguity affects the resultant thickness by two orders of magnitude, the claims are unclear and one of ordinary skill in the art would not be reasonably apprised of the claims' intended scope.

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Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

5. Claims 1 and 7 are rejected under 35 U.S.C. 102(b) as being anticipated by JP 7-074381 (made of record in IDS #3). JP '381 discloses an InGaAs distortion superlattice formed on an n-InP substrate wherein the photodetection layer comprises strained layers respectively composed of $\text{In}_{0.53+x}\text{Ga}_{0.43-x}\text{As}$ and $\text{In}_{0.53-x}\text{Ga}_{0.43+x}\text{As}$, wherein $x > 0$.

6. Insofar as definite, claims 1-8 are rejected under 35 U.S.C. 102(b) as being anticipated by Tsuji et al. '068. Tsuji discloses avalanche photodiodes having a superlattice absorption region.

a. Regarding claims 1, 2, 4, 7 and 8, note the embodiment 6 (col 10) depicted in FIG 6 wherein the 16-cycle superlattice comprises ternary InGaAs wells (first layers) that each have a compressive strain of 0.5% and a thickness of 200 Angstroms, and ternary InAlAs barriers

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(second layers) that each have a tensile strain of 0.5% and thickness of 400 angstroms. Applying these values to the equation, $L_{2nd} \leq (0.9 \times L^{1/4} \times \epsilon)$; i.e., $L = 16 \text{ cycles} \times [200 (L_{1st}) + 400 (L_{2nd})] \text{ \AA}$ $= 0.96 \text{ \mu}$; and $\epsilon = 0.5$, yields $L_{2nd} \leq 0.445 \text{ \mu}$. Since the thickness of the second layer (L_{2nd}) is 40 nm, the claims are anticipated.

b. Regarding claim 3, while Tsuji sets forth specific examples wherein the thickness of the compressive-strain layer is less than 50 nm, the disclosure is not so limited. Rather, the reference expressly states that the barriers and wells may have a thickness that is less than 100 nm (col. 3, lines 55-), which includes 50 - 100 nm.

c. Regarding claims 5 and 6, note the embodiment 5 (col 10) wherein the compressive-strained barrier (first layer) is 40 nm thick and the tensile-well (second layer) is 20 nm thick. As such, the second layer has a thickness that is one half of the first layer.

i. Alternatively, assuming arguendo that claim 5 must be interpreted such that "smaller than one-half the thickness" precludes anticipation by a layer thickness that is exactly one-half as thick than another layer--but not less than one-half as thick, it would nonetheless have been obvious to one of ordinary skill in the art at the time of the invention to have altered the thickness ratio in this direction, because Tsuji sets forth that a wide range of barrier and well thicknesses may be employed (i.e., less than 1000 Angstroms) and for various conventional reasons such as (1) the thickness of a monolayer of a particularly employed composition, particularly for thinner barriers and wells; to adjust the energy height of the well; or to adjust the

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probability of tunneling through the barrier, depending only upon the specific device application.

7. Insofar as definite, claims 1, 4, 7-9 and 11-15 are rejected under 35 U.S.C. 102(e) as being anticipated by Dries et al. '152.

a. Dries discloses strained superlattice photodetectors have compressive-strained wells and tensile-strained barriers. Note for example, the embodiment of FIG 3 wherein a strained superlattice is formed on an n-InP substrate; therein the thickness dimensions and stated strains satisfy the equation set forth in claim 4. This is true regardless of whether the strain grading layers are included in the calculation of "L" and regardless of whether 2 or 0.02 is employed for the strain, ϵ .

b. Also, strained superlattices may be composed of In_xGaAs/In_yGaAs (e.g., abstract). Further, the strained superlattice may be n-doped (e.g., Fig 2B).

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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9. Claim 9 is rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over JP '381 as applied to the claims above. Claim 9 further sets forth that the first and second layers of the superlattice are n-doped. JP '381 does not state any doping concentrations, implying that the superlattice is undoped. Nonetheless, Applicant's specification sets forth n-dopant concentrations for the superlattice layers of $1E15$ (paragraph spanning pages 17 and 18). As such, this reads on a p-i-n structure because doping concentrations on the order of $1E15$ may be considered to be undoped. See Ng, "Complete Guide to Semiconductor Devices," 1995, McGraw Hill, Inc. pp. 402-405 which discusses p-i-n photodiodes and discloses that the intrinsic, light absorption layer typically has a doping concentration that is less than $10E15$ and is generally of the same doping type as the substrate heavily doped region (pg. 402, section 50.2). Thus, the intrinsic superlattice region of JP '381 either inherently has an n-doping concentration on the order of $1E15$ or lower or alternatively it would have been obvious to one of ordinary skill in the art at the time of the invention to have set the doping concentration to be n-type and on this order of magnitude or lower, since this was the conventional doping scheme employed for p-i-n photodetectors.

10. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dries as applied to the claims above. Dries expressly states that In_xGaAs/In_yGaAs strained superlattice detectors may be employed, but does not set forth any specific examples wherein the thicknesses and strains are recited. Nonetheless, the provision of such an In_xGaAs/In_yGaAs strained superlattice

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detector that satisfies the equation would have been an obvious design choice that does not produce any unexpected results because Dries sets forth all of the general factors that would cause such a device to satisfy the equation: specifically, Dries teaches strains that are greater than 1.5% (e.g., claim 1); barriers and wells that are on the order of tens of nms; and superlattices that include on the order of 50 cycles.

Conclusion

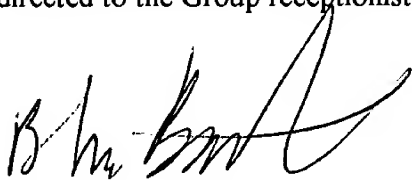
11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- a. Tsuji et al. '995
- b. Kuroda et al. '073
- c. Dutta et al. '225
- d. Pelekanos '863
- e. Kasukawa et al. '462
- f. Sakata '543
- g. Svilans '200
- h. JP '575

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INFORMATION ON HOW TO CONTACT THE USPTO

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to the examiner, **B. William Baumeister**, at **(703) 306-9165**. The examiner can normally be reached Monday through Friday, 8:30 a.m. to 5:00 p.m. If the Examiner is not available, the Examiner's supervisor, Mr. Eddie Lee, can be reached at (703) 308-1690. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

A handwritten signature in black ink, appearing to read 'B. William Baumeister', with a stylized, flowing script.

B. William Baumeister

Patent Examiner, Art Unit 2815

December 1, 2002